UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2

DATE:

SUBJECT: Responses to National Remedy Review Board and Contaminated Sediments Technical Advisory Group Recommendations for the Lower Eight Miles of the Lower Passaic River, part of the Diamond Alkali Superfund Site in Newark, New Jersey

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TO: Amy R. Legare, Chair
National Remedy Review Board

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Contaminated Sediments Technical Advisory Group

The Environmental Protection Agency's (EPA's) National Remedy Review Board (NRRB) and Contaminated Sediments Technical Advisory Group (CSTAG) (the Boards) provided advisory recommendations to EPA Region 2 related to the proposed remedy for the lower eight miles of the Lower Passaic River (Focused Feasibility Study Area or FFS Study Area[1]), part of the Diamond Alkali Superfund Site in Newark, NJ, in a memorandum dated xxxx xx, 2014.

The Region greatly appreciates the Boards' thorough review and thoughtful comments on the proposed remedial action for the site, which was discussed during the Boards' December 12-13, 2012 meeting.

The Region has incorporated many of the Boards' recommendations into the 2014 Focused Feasibility Study (FFS) and Proposed Plan. Our specific responses to the Boards' advisory recommendations are provided below. For convenience, each recommendation is presented in the order identified in your memorandum, followed by our response.

[1] The FFS Study Area is part of the Lower Passaic River (LPR) Study Area, which is the 17-mile, tidal portion of the Passaic River, from the river's confluence with Newark Bay to Dundee Dam, and its watershed, including the Saddle River, Third River and Second River. The remedial actions for the FFS Study Area and 17-mile LPRSA are discrete Operable Units (OUs) of the Diamond Alkali Superfund Site, which includes the former Diamond Alkali Company manufacturing facility in Newark, NJ, and portions of Newark Bay. Potentially responsible parties (PRPs) are currently performing a separate remedial investigation/feasibility study (RI/FS) for the 17-mile LPR Study Area and the Newark Bay Study Area.

Site Characterization

Recommendation: Based on the information provided by the Region, the Boards note that the pesticide DDT and its degradation products (DDx) are contaminants of concern (COCs) in the river sediments. The documents provided to the Boards did not provide clear information on the transport pathways of DDx. The transport pathways may have included historic direct wastewater discharge to the Passaic River, and may now include contaminated surface water runoff and groundwater upwelling to the river sediments. Information obtained by EPA at other DDT manufacturing sites indicates that chlorobenzene is typically used as a solvent and carrier for DDT at a 1:1 mass ratio during the manufacturing process. The Boards recommend that the Region confirm whether chlorobenzene is or may be a DDx co-contaminant in the soil and groundwater. In addition, the Boards recommend that additional soil and groundwater characterization be conducted to evaluate the DDx contributions and, if present, chlorobenzene as the sources to the overall DDx and chlorobenzene loads in the river sediments. If the Region identifies chlorobenzene at actionable levels, the Boards further recommend that the Region address it in its decision documents as part of the remedy selection process (either in the current Record of Decision [ROD] or in a future decision document). The Boards recommend that the Region consider as a potential alternative an enhanced (active layer component) sand cap for river stretches where mobile COCs such as chlorobenzene are associated with high groundwater discharge rates or non-aqueous phase liquid (NAPL) seepage into the river sediment.

Response: Chlorobenzene and Total DDx concentrations from sediment cores collected in 1995, 2006 and 2008 are plotted in Figures 1 and 2 (attached). Figure 1 shows surface sediment concentrations and Figure 2 shows concentrations that would be exposed after dredging in Alternative 3. In Figure 1, surface sediment concentrations of chlorobenzene are almost all non-detect, and the few detected values do not exceed 10 ppb. In Figure 2, for the surface that would be exposed after dredging in Alternative 3, most concentrations of chlorobenzene are still non-detect. Of the few detected values, all were below 50 ppb, except for one at 2,200 ppb, located in the Phase 1 Removal area, which, in 2012, was dredged down to 12 feet and backfilled, so the sediment containing that elevated chlorobenzene is no longer present. To put these values into context, threshold values for chlorobenzene intended to be conservative predictors of health effects were developed at the beginning stages of the FFS risk assessments, when the Region was screening data to determine contaminants of potential concern (COPCs) and contaminants of potential ecological concern (COPECs). The most conservative screening value for chlorobenzene was an ecological risk threshold of 410 ppb, based on Jones et al, 1997. Comparing the sediment concentration data shown in Figures 1 and 2 to the conservative threshold indicates that no chlorobenzene was detected above that threshold in the FFS Study Area. However, if, during remedial design sampling, high concentrations of chlorobenzene are found, the Region would consider an enhanced sand cap for those river stretches. Consideration of enhanced sand caps during remedial design is already included in the FFS and Proposed Plan.

Waste Characterization

Recommendation: The information provided to the Boards in the package indicates that a conservative approach was used to define which FFS Area sediments were assumed to be Resource Conservation and Recovery Act (RCRA) characteristic waste for estimating off-site disposal costs. This conservative approach resulted in the Region determining that 7–10 percent of the contaminated sediments would be treated. The Boards recommend that the decision documents contain a thorough and clear explanation regarding how the Region's RCRA determination is consistent with 40 CFR Part 261 and associated guidance, and any applicable or relevant and appropriate state regulations.

Response: The Region's waste handling analyses, summarized below, are thoroughly documented in Appendix G of the RI/FFS.

Management and disposal of dredged material from the FFS Study Area must comply with the requirements of RCRA and with the Off-Site Rule (40 CFR 300.440), which requires that CERCLA wastes be placed in a facility operating in compliance with RCRA or other applicable Federal or State requirements. Sediments in the FFS Study Area contain hazardous substances including, but not limited to, dioxins (including 2,3,7,8-TCDD), furans, DDT, PCBs, PAHs, mercury, cadmium, copper, lead, nickel and zinc. However, as explained in EPA guidance, a contaminated environmental medium such as sediment is not in and of itself hazardous waste and, generally, is not subject to regulation under RCRA, unless it "contains" hazardous waste ("Management of Remediation Waste Under RCRA" [EPA/530-F-98-026, Office of Solid Waste and Emergency Response]).[2] For purposes of offsite disposal, whether the sediment will be managed as a non-hazardous or hazardous material will be based on whether it exhibits a RCRA hazardous characteristic (toxicity, reactivity, ignitability, or corrosivity), pursuant to 40 CFR Part 261, Subpart C.

<u>For DMM Scenario B</u>: In order to estimate costs associated with off-site disposal, an evaluation was made of how the material dredged from the FFS Study Area might be classified under RCRA regulations for land disposal. It is not expected that the dredged materials would be regulated as a TSCA waste, because sampling of Lower Passaic River sediment to date has shown only one sample with Total PCB concentrations above 50 parts per million (ppm) out of more than 1,000 samples.

1. Dredged materials are managed differently depending on whether they are characterized as non-hazardous or hazardous based on RCRA regulations.

[2] The Region, after reviewing historical information and consulting with the Office of Solid Waste, determined that there is not sufficient evidence to conclude that listed hazardous waste (or non-listed waste that contains hazardous constituents) generated at the Diamond Alkali plant entered the Lower Passaic River as a listed hazardous waste and subsequently mingled with and contaminated the sediments. Because of the lengthy passage of time, it is difficult to attribute the contaminants in the sediments directly to any listed hazardous waste originating from the Diamond Alkali plant. Therefore, EPA does not have sufficient reason to conclude that the sediments contain listed hazardous waste (EPA, 2008).

   a. Dredged materials must be managed as a hazardous waste if the materials exhibit a RCRA hazardous characteristic (toxicity, reactivity, ignitability, corrosivity).
   b. Non-hazardous materials may be eligible for direct landfill disposal at a RCRA Subtitle D facility, depending on the landfill permit.

2. If the dredged materials must be managed as a hazardous waste, then they must meet the RCRA Land Disposal Restriction (LDR) standard for Characteristic Hazardous Wastes, which requires examination for underlying hazardous constituents (UHCs).
   a. Based on RCRA regulations (40 CFR 268.48-268.49), if the UHCs in the dredged materials do not exceed the alternative treatment standard (ten times the universal treatment standard [UTS]) for soil or sediment, then the dredged materials are eligible for direct disposal at a RCRA Subtitle C landfill.
   b. If the UHCs in the dredged materials exceed ten times the UTS, then the dredged materials must be treated prior to disposal to achieve either a 90% reduction in UHCs, or a reduction in UHCs to no more than 10 times the UTS. Currently, thermal treatment is the only technology known to be able to treat sediments that contain dioxin as a UHC to the applicable standards. The ash generated by this treatment can be disposed of at a RCRA Subtitle C landfill.

The Region evaluated whether the FFS Study Area dredged materials would be characterized as non-hazardous or hazardous based on the RCRA characteristic of toxicity, since past experience has shown that the sediment is not reactive, ignitable or corrosive. Sediment core samples collected in the FFS Study Area were analyzed to determine bulk sediment contaminant concentrations; samples were not analyzed using the toxicity characteristic leaching procedure (TCLP). However, samples collected during the Tierra Solutions, Inc. (TSI) Phase 1 Removal were analyzed for both TCLP and bulk sediment contaminant concentrations. Using these data, the Region developed a correlation between bulk sediment and TCLP concentrations, yielding an estimate of the bulk sediment concentrations that could potentially fail the RCRA TCLP regulatory limit for each analyte.

The Region compared the bulk sediment concentrations that could potentially fail the RCRA limits with the bulk sediment contaminant concentrations collected in 1995, 2006 and 2008 in the FFS Study Area to determine the contaminants that could be detected at levels exceeding the RCRA TCLP limits. To be conservative, the Region assumed that all samples with contaminants exceeding the RCRA limits would be found to contain UHCs exceeding ten times the UTS, and thus would require incineration. This conservative approach is consistent with the results presented in the Phase 1 Removal Action Design Analysis Report (TSI, 2010).

Based on this theoretical evaluation, there is a reasonable probability that some sediment from the FFS Study Area could exceed the RCRA TCLP limits if the TCLP test were performed. In general, the exceedance percentage for the contaminants was very low, with Silver and Selenium having the highest frequency of exceedance at 6% and 4%, respectively. Each core was assigned a volume of influence in the river using statistical polygons to estimate the volume of sediment in the FFS Study Area with contaminant concentrations that could exceed TCLP limits. From this analysis, it was estimated that 10% of dredged materials in Alternative 2, 7% of dredged materials in Alternative 3 and 4% of dredged materials in Alternative 4 might exceed TCLP limits, and, applying the conservative assumption that all sediment failing TCLP would be found to contain UHCs exceeding ten time the UTS, would therefore require thermal treatment. The disposal costs for these materials were estimated based on this assumption that thermal treatment would be required. The disposal costs for the remaining materials, 90% for Alternative 2, 93% for Alternative 3 and 96% for Alternative 4, were estimated based on direct disposal (after dewatering) in a Subtitle C landfill (consistent with the method of disposal for the Phase 1 Tierra Removal and RM10.9 Removal).

<u>For DMM Scenario C:</u> In order to estimate costs associated with local decontamination and beneficial use, the Region made two evaluations: 1) how the material dredged from the FFS Study Area might be classified for disposal under RCRA (as described above); and 2) how the end product of the decontamination technology might be classified for beneficial reuse under the New Jersey Acceptable Use Determination (AUD) process. In New Jersey, under the AUD process, contaminant concentrations in the end product must comply with current NJDEP Soil Cleanup Criteria, which are specified in the New Jersey Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS) under New Jersey Administrative Code (N.J.A.C.) 7:26D.

1. Non-hazardous dredged materials that do not contain constituents that exceed the NRDCSRS may be solidified/stabilized (e.g. Portland cement amendment), with the final product classified as a beneficial use end product, which is what the Region assumed would occur for cost estimating purposes.
2. Non-hazardous materials that contain constituents that exceed the NRDCSRS may be decontaminated by the sediment washing technology to meet the NRDCSRS requirements, with the final product classified as a beneficial use end product. For cost estimation purposes, the Region conservatively assumed that the beneficial use site would have a tipping fee associated with its use, equivalent to a Subtitle D landfill tipping fee.
3. Hazardous materials that contain UHCs exceeding ten times the UTS for sediment would likely require thermal treatment to achieve either a 90% reduction in UHCs, or a reduction in UHCs to no more than 10 times the UTS. The final product may then be classified as a beneficial use end product. The ash generated by thermal treatment would be disposed of at a RCRA Subtitle C facility.

In order to determine the cost of decontaminating FFS Study Area sediment to achieve NRDCSRS, the Region assumed that sediment washing would be capable of reducing contaminant concentrations by less than 10% to 80%, depending on the contaminant, and that thermal treatment would be capable of reducing organic contaminant concentrations by more than 99%. These assumptions are based on pilot study results and discussions with technology vendors. The 1995, 2006 and 2008 sediment contaminant concentrations from the FFS Study Area were compared with the NRDCSRS to determine whether the dredged material could achieve the requirements for beneficial use. This evaluation indicated that there is a reasonable probability that some of the sediments from the FFS Study Area would require treatment prior to meeting New Jersey's beneficial use criteria. The analytes most likely to exceed the NRDCSRS were Acetone and Benzo(a)pyrene. The Region concluded that, by volume, approximately 2% of dredged materials in Alternative 2, 1% of dredged materials in Alternative 3 and 2% of dredged materials in Alternative 4 could attain the criteria for industrial beneficial use with only solidification/stabilization being necessary. For the remaining material, sediment washing would be required (88% for Alternative 2, 92% for Alternative 3 and 94% for Alternative 4), as well as thermal treatment (10% for Alternative 2, 7% for Alternative 3 and 4% for Alternative 4).

Institutional Controls

Recommendation #1: According to the review package, some institutional controls (ICs) are already in place at this site (e.g., NJDEP fish and crab consumption advisories). The Boards recommend the Region consider whether additional ICs should be added to alternatives that have been identified, to help ensure protectiveness of human health and the environment or to help protect the selected remedy's integrity (e.g., controls to prevent disturbance of the sediment cap and dredging or remedy-associated sediment disturbance in the river reach). The Boards also recommend that, consistent with OSWER Directive No. 9355.0-89, November 2010, *Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites,* Interim Final), the Region should consider identifying in the decision documents the types of instruments that may be employed, the use restriction objectives of the ICs, the media to which the ICs would pertain and the areas for which the ICs are needed to help ensure protectiveness of human health and the environment.

Response #1: As described in the Region's NRRB package, all of the active alternatives include institutional controls (ICs) to ensure protection of human health and the environment. NJDEP's existing fish and crab consumption advisories would be enhanced with additional outreach activities conducted in municipalities on both shores of the FFS Study Area to educate community members about the advisories and to emphasize that the advisories will remain in place during and after remediation. To address the Boards' recommendation that the Region identify additional ICs to help protect the integrity of the selected remedy, the following ICs necessary to maintain cap integrity in perpetuity in Alternatives 3 and 4 are further described in the FFS and will be described in the Proposed Plan:

- Prohibitions on anchoring vessels within the FFS Study Area to prevent damage to the cap.
- Restrictions on construction and dredging in the FFS Study Area except in the federally-authorized navigation channel.
- Restrictions on construction and dredging below the depths of the federally-authorized navigation channel.
- Bulkhead maintenance agreements or deed restrictions in the FFS Study Area that specify or limit what can be done with regard to bulkhead construction or repair.

Additional ICs may be developed during remedial design.

Recommendation #2: In addition, the Boards note that the review package states that the "no-action" alternative includes continuation of existing ICs. As discussed in OSWER Directive No. 9200.1-23P, July 1999, *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents,* a "no action" alternative should not include existing ICs. The Boards recommend that, consistent with the ROD guidance, the Region remove the reference to ICs in the "no-action" alternative.

Response #2: In the FFS and Appendices, the description of the No Action alternative acknowledges the existence of fish and crab consumption advisories, which were issued by New Jersey under its public health authority. The advisories are not part of a CERCLA response action, but EPA does not have the authority to discontinue the advisories, nor would it seek to do so. The fact that the fish and crab consumption advisories exist, but are not part of a CERCLA response action, will be clearly explained in the Proposed Plan.

Ecological Risk

Recommendation #1: Based on the Region's presentation, the Boards note that 1) the FFS ecological risk assessment (FFS ERA) is largely a conservative, literature-based FFS ERA; and 2) contaminants at this site are co-distributed. The Region indicated in its package that additional ERA efforts are being conducted as part of the larger 17-mile LPRSA and Newark Bay study areas and that a full baseline ERA (BERA) will be completed for those operable units of the site. The Boards note that the FFS ERA does identify the site COCs and a risk-based justification for remediation; however, literature-based numerical, chemical-specific ecological preliminary remediation goals (PRGs) do not appear to be necessary for all identified contaminants in this proposed remedial action. Furthermore, the Boards note that contaminant–specific PRGs based upon the ongoing BERA efforts for the 17-mile and Newark Bay study areas may be different than those that could be derived from the FFS ERA. The Boards recommend that, for remedy selection purposes, the decision documents contain a 1) clear identification of the site-specific COCs posing an unacceptable risk to human health and the environment; 2) discussion of why the use of CERCLA response authority is warranted; and 3) COC-specific explanation of the PRG and cleanup levels (e.g., the Region's basis for each of the contaminant concentrations proposed as PRGs). The Boards further recommend that the decision document state how the preferred alternative will reduce concentrations of all COCs and how the final Site remedy, influenced by the site-wide BERA, will meet clean-up levels established for all COCs. This should help ensure site-wide consistency in the remedial action objectives (RAOs).

Response #1: It is the Region's assessment that the information developed for the FFS ERA is sufficient to identify the FFS Study Area COPECs and provide an ecological risk-based justification for remediation. Although literature values were consulted and used within the FFS ecological risk assessment (ERA), the ERA was driven by site-specific data and was not merely a literature-based evaluation. The approach used to characterize ecological risk in the FFS is consistent with the eight-step process recommended in *Ecological Risk Assessment Guidance* *for Superfund* (ERAGS, EPA 540-R-97-006, June 1997). Specific details are provided below.

- A screening level risk assessment (SLERA) (Steps 1 and 2) used conservative and simplifying assumptions to reach a conclusion that more than *de minimis* ecological risks exist in the FFS Study Area, and provided a rationale for conducting additional ecological risk characterization to refine the relevant spatial and temporal aspects of these risks. The SLERA was documented in the *Pathways Analysis Report* (July 2005).
- Consistent with ERAGS, the FFS ERA (Steps 3 through 7) used more realistic and technically defensible exposure and effect assumptions to generate estimates of ecological risk to support informed decision-making. Some specific examples of the refined approach are summarized in Table 1 below.
- ERAGs guidance on use of site-specific data to generate more accurate measures of ecological exposures and effects was followed in order to provide an adequate data set needed for drawing conclusions in the FFS ERA.
    - Fish and crab tissue residue data collected in the FFS Study Area were used in the FFS ERA to derive site-specific exposure point concentrations (EPCs).
    - The overall ecological risk-based PRG for 2,3,7,8-TCDD is based on site-specific reproductive effects data collected by local researchers and tabulated by the U.S. Fish and Wildlife Service (USFWS) [Kubiak et al., 2007]. This dataset is most appropriate for FFS remedial decision-making, since it is site-specific and based on what is anticipated to be the most sensitive type of exposure and life stage for the primary ecological risk driver.

Table 1: Major Differences between SLERA and FFS ERA

Attribute	SLERA	FFS ERA	Discussion
Concentration Term	Maximum value	Mean (95% UCL)	FFS ERA shifted focus to more reasonable typical exposure encountered by receptors, rather than "worst case" used in SLERA; FFS ERA used 95th percentile estimate on the arithmetic mean consistent with ERAGs.
Analytes considered	Complete set	Limited subset	Based on conservative screening conducted in SLERA, Region identified a small subset for more detailed consideration in FFS ERA. This is consistent with ERAGs.
Early life stages considered?	Not explicitly	Yes	Consistent with the more detailed focus on toxicological effects of the refined set of COPECs, FFS ERA explicitly evaluated exposures to fish and bird embryos, due to the known sensitivity of early life stages to AhR-mediated toxicity.
Spatially explicit exposures considered?	No	Yes	In FFS ERA, mudflats were evaluated as a distinct subarea within the FFS Study Area habitat. FFS ERA refinements included separate exposure concentration estimates and refined dietary composition assumptions (e.g., heron dietary exposures estimated using mummichog tissue residues in intertidal areas and piscivorous bird exposures throughout the FFS Study Area estimated using generic fish tissue residues).

Exposure Duration	1	0.7 & 1	Whereas SLERA conservatively assumed that herons are present year round on LPR, in the northern part of their range in eastern North America, many individual birds migrate south in Sept/Oct returning early the following year (Feb/Mar). As some individuals may overwinter in the LPR, both exposure assumptions were modeled in FFS ERA to evaluate the impact of this exposure parameter on risk estimates.
Toxicological benchmarks?	Conservativ e	Refined	As part of the FFS ERA refinement process, conservative toxicological benchmarks were re-assessed by EPA and Partner Agencies,[3] and revised consensus values were established for use in deriving more precise and technically-defensible risk estimates. Revised values included upper- and lower-bound numbers.
Bioaccumulativ e exposure modeling	Generic BAFs	Site-specific tissue data	Literature-derived bioaccumulation factors were used in the SLERA to derive conservative screening-level risk estimates; baseline wildlife exposures were estimated using site-specific tissue data. Although the FFS ERA used statistical sediment-tissue relationships to estimate <u>future</u> wildlife (and residue-based) exposures, these were derived using tissue data specific to the LPR. Moreover, the site-derived statistical sediment-tissue relationships were shown to be consistent with values from other similar sites and were generally less conservative than the literature values used in the SLERA.

In acknowledgement of the Boards' recommendation, the Region has revised its approach to establishing ecological risk-based PRGs. While all of the COPECs evaluated in the FFS ERA were clearly documented to cause unacceptable risks (hazard quotients [HQs] greater than 1) to some or all of the receptors evaluated, risk-based PRGs were only developed for dioxins, PCBs, mercury and DDT, as representative COPECs (based on the magnitude of HQs and number of receptors affected) and because there were multiple lines of evidence developed to evaluate how the alternatives would achieve PRGs for these four contaminants after remediation. In addition, most active alternatives (i.e., alternatives other than No Action) designed to address these contaminants would also address the other COPCs and COPECs.

Recommendation #2: The Boards note that the tissue-based avian embryo effects levels for tetrachlorodibenzo-p-dioxin (TCDD) toxic equivalency quotient (TEQ) may not be protective based on recent studies (Head JA, ME Hahn and SW Kennedy, 2008, *Key amino acids in the aryl hydrocarbon receptor predict dioxin sensitivity in avian species*) describing categories of species sensitivity relative to dioxin-like compounds. While this possible non-protectiveness likely would not change the proposed remedy for this operable unit since the ecological PRGs for the lower 8.3 miles are based on the overall lowest ecological value (site-specific sediment PRGs for oysters), the Boards recommend that the Region discuss this issue in the BERA to more accurately identify any potential uncertainties in the characterization of avian risks.

[3] The FFS and Proposed Plan were developed by EPA in consultation with the New Jersey Department of Environmental Protection (NJDEP), the support agency. In addition, the Region and NJDEP consulted with the U.S. Army Corps of Engineers (USACE), National Oceanic and Atmospheric Administration (NOAA) and U.S. Fish and Wildlife Service (USFWS), key federal stakeholders. The five agencies are called "Partner Agencies".

Response #2: The Region reviewed the recent literature (including Herve et al 2010, Farmahin et al 2012, Manning et al 2013 and the 2008 study cited by the Boards) and compared their findings with the literature that previously was reviewed and summarized by EPA in 2003 (*Analyses of Laboratory and Field Studies of Reproductive Toxicity in Birds Exposed to Dioxin-like Compounds for Use in Ecological Risk Assessment*; EPA/600/R-03/114F). The analysis of risk assessment uncertainties in the FFS BERA was revised to include a summary of this recent literature that provided further context for interpreting application of the chicken-based toxicological thresholds to estimating potential risks in wild bird populations in the FFS Study Area.

Recommendation #3: The Boards further note that, throughout the FFS ERA, the Region has presented separate TEQ exposure concentrations for both PCBs as a group and dioxins as a group, an approach that appears to be different from current Agency guidance on considering the toxic equivalency factor (TEF) approach for wildlife (EPA 100/R-08/004, June 2008, *Framework for Application of the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furans, and Biphenyls in Ecological Risk Assessment*). The Boards recommend that the Region revise these portions of the FFS ERA to address ecological exposures to all dioxin-like compounds in a holistic manner, or explain in its decision documents the basis for its approach in light of existing CERCLA guidance.

Response #3: The FFS ERA does present both separate TEQ exposure concentrations for PCBs as a group and dioxins as a group, and a total TEQ for all dioxin-like compounds in a holistic manner. The separate TEQ exposure concentrations were provided for Partner Agency reviewers who requested the ability to track PCB and dioxin effects separately. The Region has reviewed the RI/FFS and Appendices to make sure that the total TEQ for all dioxin-like compounds is presented everywhere to address this Board recommendation.

Principal Threat Waste

Recommendation: Based on the information provided by the Region, the Boards note that the remedy for the FFS Study Area seems to be driven by dioxin and PCBs, both of which are CERCLA hazardous substances. Given their concentrations, it appears that both might represent Principal Threat Waste (PTW) due to their toxicity. The Boards note that OSWER Directive No. 9380.3-06FS, November 1991, *A Guide to Principal Threat and Low Level Threat Wastes*, provides guidance on identifying PTW, as well as on the statute's preference and the NCP's expectations for treatment of PTW. The Boards recommend that the Region fully explain in its decision documents how its approach to the dioxin and PCB contamination at this site is consistent with CERCLA and the NCP, including specifically CERCLA § 121(b)(1)'s preference for treatment "to the maximum extent practicable;" CERCLA § 121(d)(1)'s requirements regarding selection of remedies that ensure protectiveness of human health and the environment and achieve (or where appropriate, waive) applicable or relevant and appropriate requirements; 40 CFR § 300.430(a)(1)(iii)(A)'s expectation that "treatment [be used] to address the principal threats posed by a site, wherever practicable;" and 40 CFR § 300.430(f)(1)(ii)(E)'s preference for treatment "to the maximum extent practicable" while protecting human health and the environment, attaining ARARs identified in the ROD, and providing "the best balance of trade-offs" among the NCP's five balancing criteria.

Response: The NCP states that EPA expects to use treatment to address the principal threats posed by a site, wherever practicable, and engineering controls, such as containment, for wastes that pose a relatively low long-term threat or where treatment is impracticable. EPA OSWER Directive No. 9380.3-06FS, November 1991, *A Guide to Principal Threat and Low Level Threat Wastes*, provides guidance on the definition of PTW and on the NCP's expectations for treatment of PTW. According to the guidance, "the principal threat/low level threat waste concept and the NCP expectations were established to help streamline and focus the remedy selection process, not as a mandatory waste classification requirement" (p. 2).

The guidance defines PTW as those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. The guidance does not establish any threshold level of toxicity or risk, but suggests that material presenting a risk of 10^{-3} or greater may be considered a principal threat. The guidance further notes that the preamble to the NCP (55 FR 8703) states that there may be situations where wastes identified as constituting a principal threat may be contained rather than treated due to difficulties in treating the wastes. Furthermore, EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (EPA, 2005) also states that "Based on available technology, treatment is not considered practicable at most sediment sites" and "It should be recognized that in-situ containment can also be effective for principal threat wastes, where that approach represents the best balance of the NCP nine remedy selection criteria."

Dioxin, PCBs and other COPC and COPEC concentrations in sediments throughout the FFS Study Area are present at levels contributing to 10^{-3} risks for humans consuming fish and crab caught in the FFS Study Area. In preparing the FFS for the lower 8.3 miles of the Lower Passaic River, the Region concluded that the principal threat/low level threat waste concept does not help streamline and focus the remedy selection process. Although the engineering and sediment transport modeling work done as part of the FFS has determined that the sediment, despite its toxicity, under current conditions, can be reliably contained, the Region will nevertheless reflect in the decision documents that it considers the most highly contaminated sediments, based on toxicity, to be principal threat wastes at the site.

The Region has considered treatment as a component of dredged material management. However, additional treatment of all the sediment in the FFS Study Area is not practicable or cost effective given the high volume of sediment and the number of COCs that would need to be addressed and lack of applicable in-situ technologies.

Remedial Action Objectives/Preliminary Remediation Goals

Recommendation #1: Based on the information presented to the Boards, the Region has established background concentrations of the risk-driving COCs. However, the package presented to the Boards does not clearly explain how background concentrations are to be used; it also is unclear regarding the Region's site-specific RAOs (e.g., it indicates both risk-based PRGs and background-based "interim" PRGs were developed). Additionally, the risk-based PRGs presented in the package appear to be based on either human health or ecological risk-based concentrations, and some of these values may be below background concentrations.

As discussed in OSWER Directive No. 9285.6-07P, May 2002, *Role of Background in the CERCLA Cleanup Program*, "Background information is important to risk managers because the CERCLA program, generally, does not clean up to concentrations below natural or anthropogenic background levels." The Boards note that site-specific modeling suggests the preferred alternative may yield post-remedy concentrations that are below background levels post multi-year remedy implementation. The Boards recommend that the Region clearly explain in its decision documents how, considering EPA guidance, information regarding background was taken into account when developing RAOs, PRGs, and final cleanup levels.

Response #1: The Region has carefully considered the effect that background contaminant concentrations will have on post-remedy conditions in the FFS Study Area, with reference to both OSWER Directive No. 9285.6-07P, May 2002, *Role of Background in the CERCLA Cleanup Program* (Background Guidance) and OSWER Directive No. 9355.0-85, December 2005, *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (Contaminated Sediment Guidance).

The Background Guidance notes that if background concentrations are high relative to concentrations of site-related hazardous substances, a comparison of background and site concentrations may help EPA risk managers make decisions concerning remedial actions. Similarly, the Contaminated Sediment Guidance states that project managers should consider background contributions to sites to adequately understand contaminant sources and establish realistic risk reduction goals. The two guidance documents recognize that generally, for reasons of cost-effectiveness, technical practicability and the potential for recontamination of remediated areas by surrounding areas with elevated background concentrations, it may not be appropriate to select cleanup levels at concentrations below natural or anthropogenic levels.

Because the Region's analyses indicate that post-remediation surface sediment concentrations would achieve levels that are lower than background concentrations, and come to fluctuate around or very near risk-based PRGs under at least two of the active alternatives evaluated in the FFS, Region 2 has chosen risk-based PRGs as its remediation goals.

<u>Development of PRGs</u>

Risk-based human health concentrations were developed first as tissue concentrations of

COPCs that would allow adult anglers to eat self-caught fish or crab from the FFS Study Area without incurring a cancer risk above EPA's risk range of 10^{-4} to 10^{-6} and a non-cancer health hazard above 1. Protective concentrations in fish and crab tissue were calculated based on the site-specific adult consumption rates of 34.6 g/day for fish and 20.9 g/day for crab used in the HHRA. Those consumption rates are equivalent to 56 eight-ounce fish meals per year and 34 eight-ounce crab meals per year. Additional risk-based tissue concentrations were developed for 12 eight-ounce fish or crab meals per year at a 10^{-4} to 10^{-6} risk level, for use as interim remediation milestones. Interim remediation milestones are contaminant levels that will be used during post-remediation monitoring in order to evaluate if contaminant concentrations in sediment, fish and crab tissue are decreasing as expected. It is expected that as fish and crab tissue levels decrease, EPA will be able to recommend to NJDEP that institutional controls be adjusted to increase consumption rates.

After development of these tissue concentrations, sediment concentrations needed to meet the protective fish and crab tissue concentrations were estimated using site-specific non-linear regressions that showed the relationship between COPC concentrations in sediments and co-located fish or crab tissue concentrations. These risk-based sediment PRGs for human health are shown in Table 2 (columns 4-11).

For the ecological risk-based PRGs, sediment PRGs that would be protective of benthic invertebrates were developed based on the sediment benchmarks used to evaluate risks in the ERA. As described in the FFS ERA, those sediment benchmarks are published literature values shown through independent research to be good predictors of toxicity. In addition, the sediment benchmark for dioxin, one of the risk drivers, is site-specific, in that it is based on reproductive effects data collected in the Newark Bay complex. The sediment PRG was calculated as the geometric mean of lower and upper bound sediment benchmark values. For crab and fish, protective tissue concentrations were developed based on the critical body residues used to evaluate risks in the ERA. Tissue concentrations that would be protective of birds and mammals were developed based on the toxicological reference values used to evaluate risks in the ERA. The tissue concentrations were calculated as the geometric mean of lower and upper bounds, which were based on no observed adverse effect levels (NOAELS) and lowest observed adverse effect levels (LOAELs). The corresponding sediment concentrations required for each species to meet the protective tissue concentrations were then estimated using the site-specific non-linear regression models described above (previous paragraph). Table 2 (column 3) presents the overall ecological risk-based sediment PRG for the major risk drivers. The overall ecological risk-based PRG for each COPEC is the lowest of the PRGs developed for each category of receptor, so that all of the organisms, including the most sensitive species, would be protected.

<u>Development of Background</u>

The contaminated sediments in the Lower Passaic River are located within a setting of interconnected waterways, including the Passaic River above the Dundee Dam, tidal exchanges with Newark Bay, and tributaries. These interconnected waterways need to be evaluated because they could continue to contribute contaminants to the Lower Passaic River following the implementation of a remedial alternative.

The northern and southern boundaries of the Lower Passaic River Study Area are Dundee Dam and Newark Bay, respectively. The Background Guidance defines "background" as constituents and locations that are not influenced by releases from the site, usually described as both anthropogenic and naturally derived constituents.

While contaminant data collected from sediments in the Upper Passaic River immediately above the Dundee Dam show the presence of historic and ongoing upstream sources of inorganics, pesticides and Total PCBs, the physical boundary of the dam isolates the proximal Dundee Lake and other Upper Passaic River sediments from any Lower Passaic River influences. On the other hand, sediment contaminant concentration gradients from the mouth of the Lower Passaic River into the Newark Bay Study Area were examined by the Region in the RI. Tidal exchange between the Lower Passaic River and Newark Bay currently results in the net transport of contaminants from the Lower Passaic River to Newark Bay.[4] As such, the Region concluded that contaminated Newark Bay Study Area sediments are too heavily influenced by site-related contamination in the Lower Passaic River to be considered "background" for the FFS Study Area.

Consequently, the Region identified concentrations of COCs in recently-deposited sediments collected from the Upper Passaic River immediately above the Dundee Dam as the background conditions for the FFS Study Area (see last column in Table 2). Using geochemical principles discussed in the RI Report, the chemicals found in the sediment samples collected from the Upper Passaic River immediately above Dundee Dam have been determined to be representative of the current water column solids contaminant concentrations being introduced to the Lower Passaic River from the Upper Passaic River.

<u>Relationship of Background to Risk-Based PRGs</u>

The potential for future recontamination of the FFS Study Area post-remediation was evaluated using the LPR-NB model. The model accounts for COPC and COPEC loads from Upper Passaic River, Newark Bay, the major tributaries, CSOs, SWOs and atmospheric deposition. Resuspension and deposition of sediments in the Lower Passaic River main stem were simulated by the sediment transport model, with initial sediment bed contaminant concentrations provided as inputs to the contaminant fate and transport model.

The model results predict that approximately 30 years after implementation of either Alternative 2 or Alternative 3, PCB and mercury sediment concentrations would be lower than

[4] The Newark Bay Study Area RI/FS was initiated based on the concern that contaminants related to the former Diamond Alkali facility located at 80-120 Lister Avenue in Newark, NJ adjacent to the Lower Passaic River had impacted Newark Bay.

background conditions identified above the Dundee Dam. The modeling predicts that, for PCBs and mercury, despite incoming contamination from Upper Passaic River, Newark Bay, the major tributaries, CSOs and SWOs, remediating the sediments of the FFS Study Area bank to bank would reduce surface sediment concentrations in that area to concentrations below background, such that it would be possible to achieve some of the risk-based PRGs. Modeling also predicts that for dioxin, Alternative 2 or 3 would achieve some of the risk-based PRGs (the dioxin background concentration is lower than the risk-based PRGs, except for the one at a risk of 10^{-6}).

This result is obtained because, while background conditions are often a limiting factor for remedial action, in the Lower Passaic River the flow of water and suspended sediment over the Dundee Dam is just one of many sources of surface water and sediment into the FFS Study Area; sediment particles coming over Dundee Dam make up about one third of particles in the FFS Study Area water column. Post-remediation, the suspended sediment entering the FFS Study Area would mix with other sources into the FFS Study Area (mainly the tidal exchange with Newark Bay) and with the cleaner solids in the water column resulting from a remediated FFS Study Area. In addition, suspended sediments depositing in the FFS Study Area would mix with the clean material placed on the river bed as part of remediation. The result of this mixing within the water column and settling, remobilization and redeposition would be surface sediment concentrations of COCs that are lower than the background concentrations above the Dam.

In accordance with USEPA risk assessment guidance (Part B, Development of Risk-Based Preliminary Remediation Goals, USEPA 1991), the point of departure for the analysis of remedial alternatives is a risk level of 10^{-6} and a non-cancer HI equal to one for protection of human health and the lowest ecological PRG set to protect the various ecological receptors evaluated at a HQ equal to one. However, remedial action at a site may achieve remediation goals set anywhere within the range of 10^{-4} to 10^{-6} and an HI at or below one (EPA, 1997). The selected remediation goals for the FFS Study Area are summarized in Table 2 (bolded numbers). For the COCs with human health PRGs, the selected remediation goals are within the risk range and at or below an HI equal to 1, so they are protective of human health. For mercury and DDT, the selected remediation goals are at an HQ of 1, so they are indicators of environmental improvement. The Region's analysis, including the results of the mechanistic modeling described above, indicates that surface sediment concentrations would fluctuate around or very near the remediation goals under at least two of the active alternatives considered in the FFS, in conjunction with natural recovery processes. For dioxins and PCBs, it is unlikely that the ecological PRGs could be met under any of the alternatives within a reasonable time frame, even with natural recovery processes. However, given that bank-to-bank remediation of the FFS Study Area would be necessary to achieve protection of human health, the ecological PRGs would not result in any additional remediation in the FFS Study Area, and those ecological PRGs were not selected as remediation goals.

As would be true of any model, there is some uncertainty associated with the mechanistic model predictions. To represent this uncertainty, the Region has established uncertainty bounds (upper and lower bounds) around the model trajectories. Post-remediation monitoring would be needed for both Alternatives 2 and 3, to evaluate whether the reduction in sediment concentrations occurs as anticipated. During the post-remediation monitoring period, EPA would use institutional controls (e.g. fish advisories and enhanced outreach) to help maintain human health protectiveness.

Table 2
Human Health and Ecological Risk-Based Sediment PRGs, and Background Sediment Concentrations

Contaminant	Units	Overall Eco Sediment PRG	Cancer Threshold Sediment PRG for an Adult						Noncancer Threshold Sediment PRG		Background Sediment Concentration
			56 fish meals per year			34 crab meals per year					
			10^{-6}	10^{-5}	10^{-4}	10^{-6}	10^{-5}	10^{-4}	56 fish meals per year	34 crab meals per year	
Mercury	ng/g	**74**	Classification — C; possible human carcinogen; There is no quantitative estimate of carcinogenic risk from oral exposure						550	45,000	720
Total PCBs	ng/g	7.8	3	30	300	1.6	51	1600	**44**	82	460
Total DDx	ng/g	**0.30**			-	-			-	-	30
2,3,7,8-TCDD	ng/g	0.0011	0.000095	0.0016	0.022	0.00043	0.005	0.058	**0.0071**	0.019	0.002

Background location for the FFS Study Area is the Upper Passaic River immediately above Dundee Dam. **Bolded** numbers are selected remediation goals.

Recommendation #2: Based upon the RAOs described in the Region's package, it appears that the overall result of implementing the Region's preferred alternative should be a significant reduction in sediment and biota contamination within the Passaic River system. However, the Boards' understanding is that the predicted reductions do not account for the feeding ranges of the potentially affected fish and crab and, therefore, may overestimate the risk reduction compared to current site conditions. As such, the Region's preferred alternative may not achieve fish or crab tissue contaminant concentrations protective of human health without the continuation of fish consumption advisories. The Boards recommend that the decision documents clearly explain how the Region's preferred approach to remedial action for this OU will achieve the RAOs developed by the Region.

Response #2: The calculated reductions in COPC and COPEC concentrations in biota were based on statistical sediment-tissue relationships that did account for the feeding range of fish and crab in the Lower Passaic River. The FFS described two critical factors related to use of sediment and tissue data for developing site-specific bioaccumulation factors: (i) determination of the appropriate spatial scale for each receptor; and (ii) the nature of the relationship between contaminant concentrations in sediment and tissue over the range of environmentally relevant concentrations. The first factor concerns the possibility that some of the organisms included in the tissue data set were exposed to contamination outside of the FFS Study Area. The second factor relates to the concern that contaminant concentrations in tissue may not be reduced at the same rate as sediment contaminant concentrations post-remediation. Although the FFS considered both questions, following the Boards' recommendation, EPA's contractor completed the following evaluations to better understand the relationships and reduce uncertainties related to the efficacy of the preferred remedy:

- Segregated existing tissue data set and evaluated the need for new statistical sediment-tissue relationship estimates. The available crab and white perch tissue data were divided into two sets depending on the likelihood that the individual organisms were located outside of the LPRSA and only recently migrated to the place of capture. The tissue data were segregated based on fish and crab life cycle information, assumptions regarding typical depuration rates for the principal risk drivers (including contaminants with high K_{ow} values) and sampling dates of the various sampling programs. The data distributions and summary statistics for each COPC and COPEC, for both species and both groups, were calculated. The results showed that the divided data set of Lower Passaic River resident fish (and crab) and the original data were statistically the same, so that new statistical sediment-tissue relationship regressions based on the divided data set would not be different from the original relationship calculations.

- Evaluated functional relationship between bioaccumulation and sediment concentrations. Several national bioaccumulation databases were queried for tissue contaminant concentrations associated with low sediment contaminant concentrations (i.e., at or below PRGs developed for the FFS). These data were added to the regressions developed to calculate statistical sediment-tissue relationships for the FFS. The addition of national data to Lower Passaic River-specific data was deemed appropriate, because, similar to biota sediment accumulation factors (BSAFs) and bioaccumulation factors (BAFs), the statistical sediment-tissue regressions are intended to be broadly applicable descriptions of the relationship between sediment and tissue concentrations. Site-specific differences are minimized in the formulation of the sediment-tissue relationships through normalization of sediment concentrations to organic carbon and of tissue concentrations to lipids. Additionally, for this evaluation, the database queries focused on the species evaluated in the FFS, further minimizing site-specific differences. In this way, the statistical sediment-tissue relationships based on low sediment concentrations were developed for use in calculating tissue concentrations post-remediation.

The results of these tasks are documented in the FFS and will be reflected in the Proposed Plan.

Remedy Performance

Recommendation #1: Based on the review package and presentation, the Boards understand that the dioxin sediment cleanup level is 5 parts per trillion (ppt), based on the protection of ecological receptors. In addition, it appears that the Region is assuming that after sediment dredging and capping in the river's lower eight miles, the surface sediment layer would achieve this concentration. The Boards note that recontamination could prevent the attainment and maintenance of 5 ppt of dioxin in sediment over time; potential sources of recontamination include, but are not limited to, resuspension caused by the cleanup itself and transport from the yet-to-be remediated parts of the LPR and Newark Bay. Although the modeled predictions of post-remediation surface sediment concentrations account for some degree of recontamination, the Boards note that there are uncertainties associated with the Region's model assumptions related to recontamination and how they are being used to predict the river system's behavior during and after remediation. The Boards recommend that a charge to the peer reviewers of the model include evaluating how the model deals with recontamination.

Response #1: The peer review of the sediment transport, organic carbon and contaminant fate and transport models was conducted in February-March 2013. The peer reviewers' charge did include a question on how the models deal with recontamination. The Peer Review Report (HDR-HQI, 2013) documents how those and all other comments were addressed. In summary, key issues raised by the peer reviewers that resulted in changes to the models included increasing the sediment transport model's ability to compute sediment accumulation (infilling), adding sensitivity analyses on the magnitude of upstream suspended solids, modifying the contaminant fate and transport model's approach to setting contaminant initial conditions and evaluating the response of the models to a one-in-one-hundred-year storm event as a sensitivity analysis.

Recommendation #2: The Boards note that it would be counterproductive to use capping material that has contaminant levels higher than the cleanup levels. The Boards recommend that the Region explain in its decision documents how it plans to make sure that concentrations of dioxin and other COCs in the capping material are below the cleanup levels.

Response #2: The Region concurs that capping and backfill material would have to be tested to ensure contaminant levels lower than remediation goals. To evaluate the availability of capping or backfill material with such low contaminant levels, results from testing of backfill material used in the Tierra Phase 1 Removal were compared to the selected remediation goals. Mercury, Total PCB, Total DDx and 2,3,7,8-TCDD concentrations in the backfill material were all non-detect, with detection limits that were lower than the FFS Study Area remediation goals. In addition, the Tierra Phase 1 Removal backfill material had grain sizes finer than what is expected to be appropriate for use as capping material for the FFS Study Area. Since the COPCs and COPECs tend to bind to fine-grained sediments, it is reasonable to assume that capping material is available with COPC and COPEC concentrations that are lower than FFS Study Area remediation goals, since even the Phase 1 Removal backfill would have met them.

Recommendation #3: As discussed in the package, the Region attempted to identify a viable decontamination technology for dredged material management (DMM), but none of the decontamination technologies evaluated during the FFS proved implementable on a commercial or full-field scale at this time. In the information presented to the Boards, the

Region indicated that it plans to write its decision documents in a way that would allow for the local decontamination and re-use (DMM Scenario C) for all or a portion of the sediment, should reliable technologies become available. The Boards commend the Region for continuing to give serious consideration to decontamination and re-use alternatives. The Boards recommend that the Region consider indicating in its decision documents that EPA may, in the future, modify the remedy to provide for sediment treatment if a viable decontamination technology becomes available.

Response #3: The Region will indicate in the Proposed Plan that EPA may in the future modify the remedy to provide for treatment of the sediment if a viable technology becomes available.

Recommendation #4: Based on information presented to the Boards, after the sediments of the FFS Study Area were found to be a major source of contamination to the rest of the LPR and Newark Bay, the Region initiated the FFS to evaluate taking action to address those sediments in the lower 8 miles of the LPR while a comprehensive RI/FS of the 17-mile LPRSA is ongoing. The Boards recommend that the decision documents clearly explain its rationale for concluding that the proposed FFS remedy would be consistent with the remedy to be selected in the future for the entire river.

Response #4: As described in detail in the conceptual site model presented in the RI and FFS, the sediments of the lower eight miles of the Lower Passaic River differ in texture from those of the upper nine miles. The river's cross-sectional area declines steadily from RM0 to RM17.4, with a pronounced constriction at RM8.3. At that location, a change in sediment texture is also observed. The river bed below RM8.3 is dominated bank-to-bank by fine-grained sediments with small pockets of coarser sediments. Above RM8.3, the bed is characterized by coarser sediments with smaller areas of fine-grained sediments, often located outside the channel. About 85% of the fine-grained sediment surface area in the Lower Passaic River is located below RM8.3.

The COPCs and COPECs tend to bind tightly to fine sediment particles[5] (*i.e.*, silts). Therefore, the highest concentrations of COPCs and COPECs tend to be found in areas that are predominantly comprised of silts, which, for the Lower Passaic River, are the lower 8.3 miles, the FFS Study Area. As shown in the NRRB Package, and as the Proposed Plan describes, sediment sampling data show that elevated concentrations of COPCs and COPECs are found throughout the surface sediments of the FFS Study Area, bank-to-bank. Data further show that median concentrations of COPCs and COPECs in surface sediments have remained almost unchanged in the last 17 years (1995-2012). Any remedy for the lower 8.3 miles selected by EPA at the conclusion of the 17-mile Lower Passaic River RI/FS would need to take into account the toxic and persistent nature of the COPCs and COPEC that exist bank-to-bank in the lower 8.3 miles. Given that the proposed FFS Study Area remedy 1) addresses the part of the 17-mile Lower Passaic River that contains a majority of the sediments to which COPCs and COPECs tend

[5] The organic contaminants are hydrophobic and tend to bind tightly to the organic carbon on fine sediment particles, while the metals are particle reactive, adhering to ionic sites on fine sediment particles.

to bind; and 2) is based on the physical characteristics of sediment texture, supported by chemical data on the spatial and temporal extent of contamination, the Region has concluded that the proposed FFS Study Area remedy would be consistent with the remedy likely to be selected for the 17-mile Lower Passaic River. As recommended by the Boards, this will be clearly described in the Proposed Plan.

Cost

Recommendation #1: Based on the information provided, the Boards note that the Region presented three DMM scenarios for alternatives 2 and 3. The Region's preferred alternative (alternative 3) includes DMM scenario B (off-site disposal), which is approximately $840 million higher (total net present value) than alternative 3 with DMM scenario A [confined aquatic disposal (CAD)]. The Boards also note that CADs have been used at other Superfund sites and by the Army Corps of Engineers as part of other dredging projects. The Boards further note that a CAD would be somewhat similar, on a conceptual basis, to the capping of the remaining contaminated sediments within the LPR, which would occur post-dredging under the Region's preferred approach. Therefore, the Boards recommend that the Region reconsider the less costly CAD scenario and clearly explain in its decision documents the basis for the Region's preferred off-site disposal scenario.

Response #1: The Region has analyzed the three DMM scenarios through the nine criteria. Following are the criteria that describe the difference among DMM scenarios and led the Region to propose selecting DMM Scenario B (Off-Site). As recommended by the Boards, this will be clearly described in the Proposed Plan.

<u>Long-Term Effectiveness and Permanence:</u> Under DMM Scenario A (CAD), the engineered caps over the CAD cells would have to be monitored and maintained in perpetuity in order to ensure that the alternatives are protective of human health and the environment over time. In contrast, there is no such requirement for DMM Scenario B (Off-Site Disposal) and DMM Scenario C (Local Decontamination), because existing landfills already have provisions for long-term monitoring and maintenance by landfill owners and operators.

<u>Reduction in Toxicity, Mobility, or Volume Through Treatment:</u> Under DMM Scenario A (CAD), only the mobility of the COPCs and COPECs removed from the FFS Study Area would be effectively eliminated, not through treatment, but by sequestering the dredged sediments in the CAD cells under an engineered cap that would need to be monitored and maintained in perpetuity. There would be no treatment technology employed, so there would be no reduction in the toxicity or volume of the COPCs and COPECs.

Under DMM Scenario B (Off-Site Disposal), the toxicity, mobility, and volume of the COPCs and COPECs removed from the FFS Study Area would be reduced by incinerating approximately 4-10% of the sediment (equivalent to 30,000 to 790,000 cy), depending on the alternative. Actual amounts incinerated would depend on the results of characterization for disposal.

Under DMM Scenario C (Local Decontamination), the toxicity, mobility, and volume of the COPCs and COPECs removed from the FFS Study Area would be reduced by thermally destroying approximately 4-10% of the sediment (equivalent to 30,000 to 790,000 cy), depending on the alternative; and by treating approximately 88-92% of the remaining dredged materials (equivalent to 780,000 to 6,970,000 cy) through a sediment washing technology.

Short-Term Effectiveness: Under DMM Scenario A (CAD), the CAD cells were assumed to be sited in the part of Newark Bay where the thickest layer of clay (approximately 60 feet) is likely to be found. Dredged materials from the FFS Study Area would be barged to the Newark Bay CAD site so that an upland sediment processing facility on the banks of the Lower Passaic River or Newark Bay would not be necessary. This would minimize on-land impacts to the community, but increase traffic in the bay. Since major container terminals are located in Newark Bay near the CAD sites that the Region considered in the FFS, increased barge traffic to and from the CAD site may interfere with existing port commercial traffic and increase the potential for waterborne commerce accidents. While dredged materials would also have to be barged to an upland processing facility under DMM Scenarios B (Off-Site) or C (Local Decontamination), an FFS-level survey of land along the FFS Study Area shoreline showed a number of locations suitable for an upland processing facility, so that the impact of increased in-water traffic associated with DMM Scenarios B and C could be minimized and interference with the major container terminals in Newark Bay could be avoided as much as possible.

Under DMM Scenario A, construction and operation of the CAD site could have substantial impacts on the aquatic environment, some of which could be lessened through engineering controls. CAD cells in Newark Bay operated without any dissolved and particulate phase controls were modeled over short time periods. Modeling results indicated contaminant losses from the CAD cells of approximately one percent of the mass placed, even after the short time period modeled (seven days), and assuming placement of small amounts of dredged materials in the CAD site (approximately 38,400 cy). This loss could cause contaminant concentrations in Newark Bay surface sediments to increase by approximately 220% for 2,3,7,8-TCDD, 10% for PAHs (represented by phenanthrene) and 35% for PCBs (represented by PCB-77) in small areas of the bay. Based on these modeled results, the CAD conceptual design used for developing DMM Scenario A in the FFS includes sheet pile walls on all sides and a silt curtain across the entrance channel, intended to lessen the migration of dissolved and particulate-phase contaminants out of the CAD cells during construction and operation. Even with the use of sheet pile walls and a silt curtain, some of the dissolved phase contamination could still escape during dredged material disposal.

Intertidal and subtidal shallows, such as those where CAD cells would be located, provide valuable habitat for various aquatic species, including areas designated by NOAA as Essential Fish Habitat. Operation of the CAD site would involve discharging dredged materials into the waters of the U.S. for 11 years under Alternative 2, 5 years under Alternative 3 and 2 years under Alternative 4. The area of the open waters subject to temporary impacts from construction and operation of the CAD site would be approximately 171 acres for Alternative 2, 80 acres for Alternative 3 and 19 acres for Alternative 4. In addition to restoring the bay bottom at the completion of the project, compensatory mitigation for the CAD site would be required; that is, provision of a separate mitigation site to offset temporal ecological losses to habitat and their functional value. For FFS cost estimation purposes, local mitigation banks have been tentatively identified to provide the mitigation necessary to offset the temporal losses associated with the Alternatives 3 and 4 CAD site. Existing mitigation banks could only provide about 55% of the total mitigation acreage necessary to offset the temporal losses associated with the Alternative 2 CAD site. Additional acres could be provided through restoration of sites identified in USACE's Hudson-Raritan Estuary Comprehensive Restoration Plan (USACE, 2009) and Lower Passaic River Ecosystem Restoration Plan. The cost of mitigation is included in the cost of the alternatives that include DMM Scenario A. Furthermore, in addition to habitat loss, there is the potential for fish and semi-aquatic birds moving into the open CAD cells during their 2- to 11-year operation and being exposed to highly concentrated contamination by direct contact or ingestion of prey.

DMM Scenarios B and C would have much less impact on the aquatic environment than DMM Scenario A, because they would not involve discharge of contaminated sediments through the water column and into CAD cells. While DMM Scenarios B and C have greater on-land impacts due to the need for an upland processing facility, those impacts can be mitigated through proven technologies such as air pollution control technology and buffer zones around construction sites.

<u>Implementability:</u> DMM Scenario A (CAD) is a technically viable, cost effective solution that has been constructed and maintained in a protective manner in other locations, including Newark Bay, and Superfund sites such as New Bedford Harbor and Puget Sound Naval Shipyard. In 1997-2012, a CAD cell with a capacity of 1.5 million cubic yards was operated in Newark Bay by the Port Authority of New York and New Jersey and USACE for the disposal of navigational dredged material from the Newark Bay watershed (not for disposal of sediment dredged for environmental cleanup).

However, in this case, DMM Scenario A (CAD) will face significant administrative and legal impediments, because the State of New Jersey has asserted ownership of the bay bottom and strongly opposes construction of a CAD site in Newark Bay, citing the high toxicity and unprecedented volume of contaminated sediment as a primary reason it should not be handled in the aquatic environment. The State's position is clearly articulated in letters dated November 28, 2012 from Governor Chris Christie to former EPA Administrator Lisa Jackson and March 10, 2014 from NJDEP Commissioner Bob Martin to EPA Administrator Gina McCarthy.

Unless the State were to change its position, its opposition is likely to make DMM Scenario A administratively infeasible. Given the State's current position, DMM Scenario A (CAD) is unlikely to satisfy the NCP balancing criterion of implementability and the modifying criterion of state acceptance.

For DMM Scenario B (Off Site), administrative feasibility is less of a concern, although siting a 26- to 28-acre (depending on the alternative) upland processing facility may be challenging in the dense urban areas around the Lower Passaic River and Newark Bay. For DMM Scenario C, administrative feasibility is less of a concern than for DMM Scenario A but more of a concern than DMM Scenario B, because Scenario C requires more upland area for dredged material processing (36 to 40 acres depending on the alternative). It also involves the construction of a thermal treatment plant, which may be subject to more stringent limitations on air emissions. In Governor Christie's November 28, 2012 letter, the State also expressed opposition to siting a thermal treatment facility near densely populated urban areas that are already burdened with environmental impacts, particularly from air pollutants. However, the letter acknowledged that decontamination technologies such as those described in DMM Scenario C should be considered in conjunction with off-site disposal.

<u>Conclusion:</u> While Alternative 3 with DMM Scenario B is more costly than with DMM Scenario A, off-site disposal offers more long-term effectiveness and permanence than CAD cells, because CAD cells require additional monitoring and maintenance in perpetuity while existing landfills already have provisions for long-term monitoring and maintenance by landfill owners and operators. Off-site disposal meets the statutory preference for selecting remedial actions that employ treatment technologies that permanently and/or significantly reduce the toxicity, mobility or volume of hazardous substances, while CAD cells do not. Off-site disposal does not involve the discharge of contaminated sediments through the water column of Newark Bay, while CAD cells do; although off-site disposal involves more on-land impact on the community and workers, those impacts would be mitigated by proven technology, while the impacts of CAD cells on the aquatic environment of Newark Bay may be partially mitigated by technology but leave enough temporal impacts that substantial compensatory mitigation would be required. Finally, CAD cells in Newark Bay are likely to be administratively infeasible, because the State of NJ, which has asserted ownership of the bay bottom, strongly opposes them.

Recommendation #2: In addition, the Boards note that the Region's considered disposal scenarios did not include an upland confined disposal facility (CDF). At other Superfund sites, EPA has selected CDFs for contaminated sediment, and based on information presented to the Boards, the Region may be considering a CDF for the disposal of 160,000 cy of sediment from the Phase 2 Tierra removal. The Boards recommend that the Region explain in its decision documents the rationale for not considering and including an alternative involving an upland CDF for the LPR cleanup.

Response #2: The FFS did consider an upland confined disposal facility (CDF) in the initial identification and screening of general response actions, remedial technologies and process options (FFS Chapter 3). However, an upland CDF was not considered implementable, due to the difficulty in identifying and obtaining approval of a location, due to the lack of permanently available and suitable vacant land large enough to site a CDF for the active alternatives in the densely populated urban areas surrounding the FFS Study Area and Newark Bay. Descriptions of the CDF acreage calculations and survey of available land are provided in the FFS.

Modeling

Recommendation #1: The Boards recommend that the Region's schedule allow sufficient time to address external peer reviewers' and the CSTAG's comments on the Region's sediment transport, organic carbon, and contaminant transport and fate models before the proposed plan is released. Doing so should give the Region an opportunity to address any potential deficiencies identified by the peer reviewers and the CSTAG, and to make any appropriate modeling modifications, including re-running the models, if necessary. Finally, the CSTAG chair requests receipt of a copy of the modeling report when the Region sends it to the external peer reviewers.

Response #1: The Region revised its schedule to allow for sufficient time to conduct an external peer review of the sediment transport, organic carbon and contaminant fate and transport models, make modifications to the models to address the reviewers' comments and re-run the models. As a result, instead of issuing a Proposed Plan in early 2013 as originally planned before the NRRB meeting, the Region now expects to issue the Proposed Plan at the beginning of 2014. The Region sent the modeling reports and charge to the peer reviewers to CSTAG as requested.

Recommendation #2: Since it may not be practical to perform a formal uncertainty analysis for fate and transport models, the Boards recommend that the Region perform an extended sensitivity analysis for all three models used to simulate the FFS' remedial alternatives. The results from this analysis should provide a useful estimate of the degree of uncertainty associated with the 60-year remedial alternative simulations. The Boards further recommend that the resulting uncertainty bands be taken into account during the remedy selection process.

Response #2: The EPA guidance document *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (EPA, 2005) discuses uncertainty analyses for models such as those used in the FFS. The document recognizes that a traditional uncertainty analysis is not feasible at this time given the complexity and run times of these models, and offers the approach used in Connolly and Tonelli (1985) as an alternative method to assess model uncertainty.

An uncertainty analysis was performed on the sediment transport, organic carbon and contaminant fate and transport models using the approach outlined in Connolly and Tonelli (1985). Using this approach, the uncertainty cannot be propagated from one model to the next, but the uncertainty in each successive model includes the cumulative uncertainty associated with the preceding model(s), as well as the uncertainty in its own calculations. For each of the models, the difference between the model calibration results and data were calculated as a percentage of the data. The difference was then applied as an upper and lower bound around the calculation of the projected model results for the four remedial alternatives analyzed in the FFS. For the sediment transport model, the uncertainty analysis was conducted for the predicted water column solids compared to the physical water column data collected by the CPG in 2009 and 2010 and sediment accumulation compared to differences between bathymetric surveys. For the organic carbon model, uncertainty calculations were conducted for available water column particulate organic carbon, water column dissolved organic carbon, and sediment fraction organic carbon data (all data presented in Appendix BIII of the modeling report). For the contaminant fate and transport model, the analysis was conducted for the contaminant datasets presented in Appendix BIII for all 48 contaminants modeled. The resulting uncertainty bounds were added to the figures in the FFS that present modeled future surface sediment contaminant concentrations. As discussed in the FFS, model uncertainty bounds for surface sediment COPC and COPEC concentrations under Alternative 1 do not overlap with those under Alternatives 2 and 3, post-remediation. Model uncertainty bounds for Alternative 1 and Alternative 4 do overlap post-remediation. This indicates that the post-remediation modeled surface sediment contaminant concentrations under Alternatives 2 and 3 are significantly lower than those under Alternative 1, while the post-remediation modeled surface sediment concentrations under Alternative 4 are not significantly different than those under Alternative 1.

Documentation

Recommendation #1: The information presented to the Boards reflected many of the site's complex design issues associated with dredging, dewatering, resuspension, and capping. Consistent with the NCP and existing CERCLA guidance documents (e.g., the 1999 ROD guidance), the Boards recommend that the Region's decision documents ensure meaningful public participation by describing in sufficient detail the relevant aspects of potential alternatives (e.g., dredging technology and its associated impacts, capping size and thickness, sand thickness, etc.), recognizing that some details may be appropriately left for the remedial design phase. The Boards believe such an approach should help the Region achieve RAOs and cleanup levels in a manner that is timely in both remedy planning and implementation while also ensuring CERCLA and the NCP consistency (e.g., ensures human health and environmental protectiveness by meeting ARARs, realizing cost-effectiveness, etc.).

Response #1: The Region acknowledges the need to describe the relevant aspects of the alternatives evaluated in the FFS in sufficient detail to ensure meaningful public participation, while leaving the identification of specific technologies to the remedial design phase. The FFS does describe the following:

- The FFS describes various environmental dredging technologies, and identifies mechanical dredging for cost estimation purposes, although some cost information for hydraulic dredging is also included. Whether dredging is performed mechanically or hydraulically, as well as the specific dredging equipment to be used, will be determined during remedial design.
- The FFS describes the thickness of the backfill and engineered cap for dredging volume and cost estimation purposes. The FFS also describes the grain size of the sand and size of the armor stone used to build the engineered cap, so that modeling can be performed to estimate how thick the engineered cap may need to be to withstand a 100-year storm. This information is used for cost estimation purposes. The FFS and Proposed Plan acknowledge that "Final dredging depths may be refined in the remedy design, and would include enough dredging to ensure cap stability and integrity" and "During remedy design, appropriate enhanced capping technologies, such as additives

(e.g., activated carbon or organoclay) to create an active cap or thin layer capping technologies would be considered in areas where necessary or where conditions are conducive to such approaches."

- The FFS describes various dewatering technologies and identifies mechanical filter presses for cost estimation purposes. However, selection of specific dewatering technology would be determined during remedial design.
- The FFS describes the various decontamination technologies that have been tested at the bench- or pilot-scale levels in the NY/NJ Harbor Estuary, and identifies thermal treatment and sediment washing for cost-estimation and implementability evaluation purposes. However, selection of specific decontamination technologies would be determined during remedial design, if decontamination is part of the selected remedy.

Recommendation #2: In the package provided to the Boards, the Region screened out alternative 4 because the model predicted it would not achieve protective levels. The Boards recommend that the Region, in its decision documents, further explain the rationale for screening out this alternative, including an explanation as to whether ICs could have been used to help ensure protectiveness of human health.

Response #2: The Region has revised the FFS and Proposed Plan to carry Alternative 4 through the nine criteria in the FFS. The FFS shows that since, under Alterative 4, human health and ecological risk levels would remain up to two orders of magnitude above protective goals 30 years after construction (duration of the model simulations), it would not be reasonable to expect natural recovery processes to result in achieving protective goals in the foreseeable future beyond the model simulation period. Since cancer risks remain far outside EPA's risk range and non-cancer health hazards are above EPA's goal of an HI of 1, Alternative 4 would incorporate ICs such as fish and crab consumption advisories enhanced by additional outreach to ensure protectiveness. Unlike Alternatives 2 and 3, Alternative 4 would primarily rely on fish and crab consumption advisories for protectiveness in perpetuity, since they would remain in place in the foreseeable future without any change in stringency. Carrying Alternative 4 through the nine criteria provided an opportunity to explain in greater detail why Alternative 4 was not the preferred alternative.

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